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The Evolution of an Industrial Cluster in China

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INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

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ABSTRACT

We use two rounds of surveys, taken in 2000 and 2008 in the Zhili Township children's garment cluster in Zhejiang Province, to examine in depth the evolution of this industrial cluster. Firm size has grown on average in terms of output and employment, and increasing divergence in firm sizes has been associated with a significant rise in specialization and outsourcing among firms in the cluster. Although the investment amount needed to start a business has more than tripled, this amount remains low enough that formal bank loans remain an insignificant source of finance. Because of low entry barriers, the number of firms in the cluster has risen, driving down profits and bidding up wages, particularly since the year 2000. Facing severe competition, more firms have begun to upgrade their product quality. By the year 2007, nearly half of the sampled firms had established registered trademarks and nearly 20 percent had become International Office of Standardization (ISO) certified.

Keywords: China, cluster, industrialization, growth

1. INTRODUCTION

China's rapid rural industrialization seems to defy the conventional wisdom that high transaction costs imply vertical integration. Its rapid industrialization has been accompanied by the emergence of numerous "specialty cities" of a particular kind. Thousands of firms, large and small, many specialized in a strictly defined production process, are agglomerated in a densely populated region, where a specific manufactured consumer good is churned out in the millions (if not billions) annually. Many formerly rural towns in the coastal areas have become specialized in the manufacture of a specific product, billing themselves as the world's "socks city," "sweater city," "kid's clothing city," "footwear capital," and so on. While these rapidly growing rural industries have been a major engine of China's unprecedented economic growth in the last two decades, their role in China's development and growth process can be easily oversimplified. Moreover, there are signs that these industries' role as a source of growth is reaching its limit. Competition at the global level, product market level, and on the labor market side is limiting output prices. At the same time, as China's growing prosperity is reflected in real wage increases, manufacturing costs are rising because increases in productivity do not keep pace with rising labor costs. Despite numerous popular media reports on these phenomena (for example, Deering 2008; Lee 2008), few studies have rigorously investigated the mechanisms behind the emergence and evolution of these clusters.

Cluster-based rural industrialization not only plays a significant role in China's industrial growth but has also been important in the early stages of industrialization in other East Asian countries and many European countries (Hayami 1998, World Bank 2008). Many clusters are initially formed as agglomerations of small and medium-sized enterprises (SMEs) (Schmitz 1995; Schmitz and Nadvi 1999). Because most SMEs are generally labor intensive, the cluster-based rural industrialization model is conducive to generating nonfarm employment and is suited to the demographics of many developing countries, which often have low capital-labor ratios and high population density (Hayami 1998). Therefore, it is important to study the mechanism of cluster formation in developing countries.

Most studies on the formation and evolution of clusters in developing countries are based on retrospective surveys and very few have tracked firm performance over a long period of time (Sonobe and Otsuka 2006). In this paper, we use two rounds of surveys, taken in 2000 and 2008 in the Zhili Township children's garment cluster in Zhejiang Province, to examine in depth the evolution of market structure and productivity.[1] Three decades ago, most people in this rural town were paddy farmers. Nowadays Zhili Township encompasses one of the largest children's garment production centers in China and the world. In 2006, a trade report stated that there were over 5,000 children's garment manufacturers in Zhili Township (Wu, Yue, and Sim 2006). In this cluster, the production of garments has been divided into specific phases. Many of the production tasks are undertaken by family workshops. Recently, because of high labor and land costs, some enterprises have begun to subcontract production to firms in neighboring Anhui Province. An in-depth case study of the evolution of this rural industrial cluster can help shed light on the reasons for the success of this important source of China's rapid industrialization and productivity growth over the past several decades as well as on its limitations.

We find that in the initial stages of cluster formation, because of low capital and technology barriers to entry, competition in the product market was intense and formal education was not an important characteristic of owners/managers. China's initial industrialization path since economic reform in the late 1970s has been labor-intensive (Lin, Cai, and Li 2003). Recently, shortage of skilled laborers has become increasingly troublesome. In the later years covered in our surveys, we observe a drop in profit that is driven not only by competition in the product market but also by rising labor costs. This pressure has induced firms to invest more in design, branding, International Office of Standardization (ISO) certification, and quality control so as to climb the value chain. An offsetting cost trend has been a tendency toward production specialization and outsourcing. In the next section we describe basic features

[1] See Sonobe, Hu, and Otsuka (2002) for a description of the first-round survey.

of the Zhili children's garment cluster; in section 3 we outline major aspects of the evolution of the Zhili cluster since 1990; section 4 draws conclusions and implications for China's economic growth and development.

2. A BRIEF HISTORY OF ZHILI CLUSTER

Zhili Township is located in northern Zhejiang Province, close to Taihu Lake, between Hangzhou and Shanghai. Historically, Zhili was an important silk and weaving production center. The word "zhili" means "weaving town" in Chinese. Population density in Zhili has been high for hundreds of years. In the planned economic era, because of limited land, income from agricultural was no longer sufficient. As a result, many farmers produced pillow covers and bedding at home to generate side income, even though this activity, called the "tail of capitalism," was illegal at the time. Although the local government tried to oppress these private industrial activities, Zhili's reputation as a bedding production center spread widely. After the central government adopted reform policies in the late 1970s, the local government reversed its opposition to private entrepreneurial activities. In the early 1980s, the local township government set up a bedding-products marketplace.

By the mid-1980s, the market for bedding products became saturated. Some Zhili merchants who specialized in selling bedding products all over China spread the word that children's garments were in short supply. As a result, a few farmers started producing children's clothes at home. Some family members made clothes while others traveled to sell the clothes in various cities. Neighbors observed this success and began to produce children's garments in their homes. By the late 1980s, more than 10 villages in Zhili Township were producing children's garments. The growing market facilitated the emergence of specialized merchants who purchased children's clothes produced in Zhili and sold them in rented counters in department stores all over China. Concurrently, several wholesale marketplaces of children's garments were set up in the Zhili town center.[2]

Since the 1990s, the production process itself has become specialized. Many farmers moved their production to the Zhili town center. They either bought or rented a three-story house that served as quarters for living, dining, and working. The first floor usually was a store and sometimes was used for production as well, while production was often concentrated in the second floor. Workers slept on the third floor. Although the rent was much higher in the Zhili town center than in nearby villages, these costs were more than offset by the benefits of agglomeration, including better market information, reduced marketing costs, and access to a centralized labor market. Additionally, having a storefront house sent a strong signal of credibility and quality to merchants who came from outside the local market area. By 1999, there were already about 1,800 such "three-in-one" workshops. These stores mainly sold their own products, which were regarded as being of higher quality than those produced in farmers' houses in nearby villages.

The success of Zhili's business model attracted merchants to order children's garments from either the wholesale markets or the workshop storefronts. In 1999, the wholesale markets sold 75 million units, with sales of 1.4 billion yuan. In 2000, to meet the rapidly increasing demand, the township government built the eighth wholesale marketplace. The products from nearby villages, which were generally of lower quality than those produced in the storefronts, were primarily sold in these wholesale markets. Fierce competition led to lower prices and profit margins in the wholesale markets, and many producers responded by relocating to the town center. Of course, the increasing demand for preferred locations drove up housing prices, which approximately doubled between 1995 and 2000. Thus, entry-level capital requirements rose apace.

In addition to the rapid development of wholesale markets, related businesses emerged, such as button and zipper production workshops, computer design studios, machinery sales and repair stores, and packaging and logistical services. The town center was expanded from a narrow, 0.5-kilometer street to an area of four square kilometers, including two three-star hotels, more than three dozen small hotels, and hundreds of restaurants. By 2005, Zhili had more than 6,000 enterprises engaged in children's garment production, employing more than 200,000 workers and accounting for one-third of the national market.

[2] See Stigler (1951) for insight into how the division of labor interacts with industrial growth.

However, since 2005, the cluster has faced new challenges. Employers report that there is a labor shortage, with skilled workers in increasingly short supply. Moreover, on September 14 and October 19 in 2006, two fatal fire accidents resulted in the deaths of 14 and eight people, respectively. These disasters received wide media attention and caused local governments to take various safety measures. In particular, three-in-one workshops, where workers live, dine, and work in the same place, were required to install fire exits. Other strict safety standards were also put into place.[3] These new standards raised workshops' costs, which were already higher because of more expensive labor. Local enterprises adapted in different ways. Some installed more capital-intensive production lines, reducing labor requirements while upgrading production quality. Other enterprises have outsourced production to lower-wage regions in neighboring Anhui Province.

The local government helped firms to adjust to the changing environment and to improve their ability to compete in domestic and international markets. Perhaps most important, a new quality-inspection center was established to randomly check the quality of local products. Second, preferential treatment was given to firms with respected brand names, including granting access to land at reduced prices.

[3] See http://news.sohu.com/20060914/n245347537.shtml and http://news.eastday.com/eastday/node81741/node81763/node167187/u1a2391492.html.

3. BASIC FEATURES OF THE INDUSTRY

Table 1 reports summary statistics for the Zhili cluster and for firms in the textile and garment industry in China, Zhejiang Province, and Huzhou City in Zhejiang taken from the 2004 China Economic Census.[4] In comparing our sample with the 2004 China Economic Census it is important to note that the 2004 Census disproportionately covers larger enterprises than those we surveyed in Zhili. Thus, we believe that our survey is complementary to the economic census in that it provides a better coverage of the range of firms at the dynamic small-to-medium size range than does the China Economic Census. For example, in Huzhou City (a prefecture city that contains Zhili), the Census covers only 1,492 firms in the textile and garment sector, and their median output in 2004 was 2,466,000 yuan. In Zhili Township alone, there are at least 5,000 workshops engaged in children's garment production with median output in 2005 of 845,000 yuan (Zhili Township Government 2009) only one-third the reported median output of the Huzhou enterprises (all monetary values are expressed in real terms, in 1990 values). When firm size is measured in terms of value added or number of workers, the difference between the Zhili firms and those in Huzhou City is not as stark. The ratio of median value added of the Zhili firms to those in Huzhou is 82 percent, and the comparable ratio for employment is 67 percent. The median share of wages in value-added terms is nearly the same in the Zhili, regional, and national samples.

Table 1. Summary statistics

	Aggregation Level and No. of Firms		Output Value 1,000 yuan	Value Added 1,000 yuan	Capital/ Labor 1,000 yuan	Wage/ Value Added	Firm Size No. of Workers	Annual Wage 1,000 yuan
Mean	China 2004	118,841	6,832	1,242.92	109.71	0.71	99.88	5.15
	Zhejiang 2004	24,563	7,221	1,320.40	140.69	0.67	79.74	5.80
	Huzhou 2004	1,492	7,833	1,216.71	146.36	0.58	68.38	6.11
Median	China 2004	118,841	1,648	280.44	54.55	0.59	35.00	4.58
	Zhejiang 2004	24,563	1,857	295.28	71.93	0.57	30.00	5.29
	Huzhou 2004	1,492	2,466	335.11	85.53	0.52	30.00	5.55
	2008 Zhili Survey							
Mean	2000	60	904	378.02	14.84	0.53	28.2	7.42
	2005	116	2,508	718.91	25.81	0.51	45.5	9.15
	2006	123	2,703	758.52	24.33	0.53	50.0	9.62
	2007	135	3,015	884.20	23.81	0.55	50.8	11.08
Median	2000	60	599	217.91	7.01	0.49	20	7.20
	2005	116	845	275.58	16.02	0.54	20	8.95
	2006	123	967	340.96	15.65	0.55	26	9.87
	2007	135	929	291.55	16.80	0.56	26	11.16
	2000 Zhili Survey							
Mean	1990	34	390	119.29	7.34	0.39	9.1	5.23
	1995	81	413	118.04	8.03	0.40	11.2	4.60
	1997	100	513	134.13	11.94	0.48	13.2	5.00
	1999	120	565	118.34	16.86	0.56	16.0	5.19
Median	1990	34	300	81.40	6.30	0.28	8.0	4.80
	1995	81	292	72.00	7.21	0.37	10.0	4.39
	1997	100	348	81.80	11.10	0.50	12.0	4.88
	1999	120	401	74.78	15.76	0.57	13.0	5.11

Note: China, Zhejiang, and Huzhou data calculated by authors from the China Economic Census in 2004. They include data for textile and garment enterprises, whereas the Zhili sample contains only manufacturers of children's garments.

[4] Evidently many small workshops were closed. In our effort to link the 2000 and 2008 surveys, we tried to locate firms included in the 2000 survey and were told that many had been in small shops that were torn down and replaced with newer house/workshop structures.

Apart from the market pressure explanation, lowering entrepreneurial risk would also lead to the decline in returns. However, it is difficult to draw conclusions about aggregate levels of risk using retrospective data. We performed a Kolgomorov-Smirnov test on firm age in the 1999 and 2007 samples and were unable to reject the null hypothesis that there was no significant difference in the distribution of firm age across both samples. The implications of this for the level of entrepreneurial risk are not clear without additional information regarding changes in the rate of firm entry and exit in the cluster.

Mean output value of the surviving firms increased significantly. By 2007, the average firm produced about 75 percent more than those in the 2000 sample. In the 1990s, this pattern is also evident although less pronounced, with mean output increasing about 46 percent over the sample period.

The data indicate that these are small enterprises, but they exhibit large variation in size and performance. The median number of employees was as few as eight in 1990 and was only 26 in the last year of the 2000 sample. In the last year of the 2000 survey, the ratio of the mean number of employees in the top quartile of firms to the mean in the lowest quartile was 4; in the last year of the 2008 survey, the comparable ratio was nearly 11. The dispersion of output value is even larger, equal to nearly 30 in the last year of the 2000 survey and nearly 33 in 2007, the last full year covered in the 2008 survey.

A major feature of these clustered enterprises is a low entry barrier in terms of initial investment. As reported in Table 2, firms starting up in the 1980s report median initial investment of approximately 7,700 yuan in the 2000 survey and 36,200 yuan in the 2008 survey (in real terms, with 1990 as the base year). Firms reported in the 2000 survey starting in the 1990s reported a median startup investment of 16,000 yuan, or a typical worker's wage income of one and a half years, while those in the 2008 survey reported 75,000 yuan. Among the firms in the 2000 survey, virtually all initial financing came from the principal or his family. Among the firms surveyed in 2008, the proportion of initial investments obtained from formal bank loans has been small. However, the mean proportion of initial investments obtained from formal bank loans grew from a negligible amount for firms that started operations before 1990 to almost 13 percent in 2007. The findings are consistent with early studies (Huang, Zhang, and Zhu 2008; Ruan and Zhang 2009) of two other rural industrial clusters in Zhejiang Province—that is, the lower entry barriers that are characteristic to clustering enable more firms to participate in the nonfarm production process.

Table 2. Initial investment

Year Founded	Number of Firms	Initial Investment (10,000)		Proportion of Initial Investment from a Bank (%)
2008 Survey		Mean	Median	
1982–1990	8	4.07	3.62	0.00
1991–1995	10	14.79	3.40	3.3
1996–2000	41	5.94	4.01	1.7
2001–2007	75	25.06	7.50	4.1
2000 Survey				
1980–1990	35	1.11	0.77	No funding from formal lenders
1991–1995	47	1.33	1.02	or government
1996–1999	39	2.45	1.60	

Note: Initial investment deflated by price index for investment in fixed capital, Zhejiang 1990 = 1.00. See Fleisher, Li, and Zhao (2008). Deflator values are 1982–90, .689; 1991–95, 1.47; 1996–2000, 1.87; 2001–2008, 2.0; 1980–90, .65; 1996–99, 1.87.

Table 3 and Figures 1, 2, and 3a and 3b summarize features of wages and profits. Firms in both samples show a sharp increase in the proportion of wages in value added in both surveys, but the causes are quite different. Profit as a share of valued added declined by roughly half among firms in the 2000 sample and by about 15 percent in the 2008 sample. Monthly wages in our sample of firms grew less rapidly than the provincial mean for workers in collectively owned firms in Zhejiang between 1990 and 2000, but the growth rates of the two series exhibit substantial convergence in the period 1999–2007. In the 2000 sample, wages were roughly steady while product-market competition evidently forced output

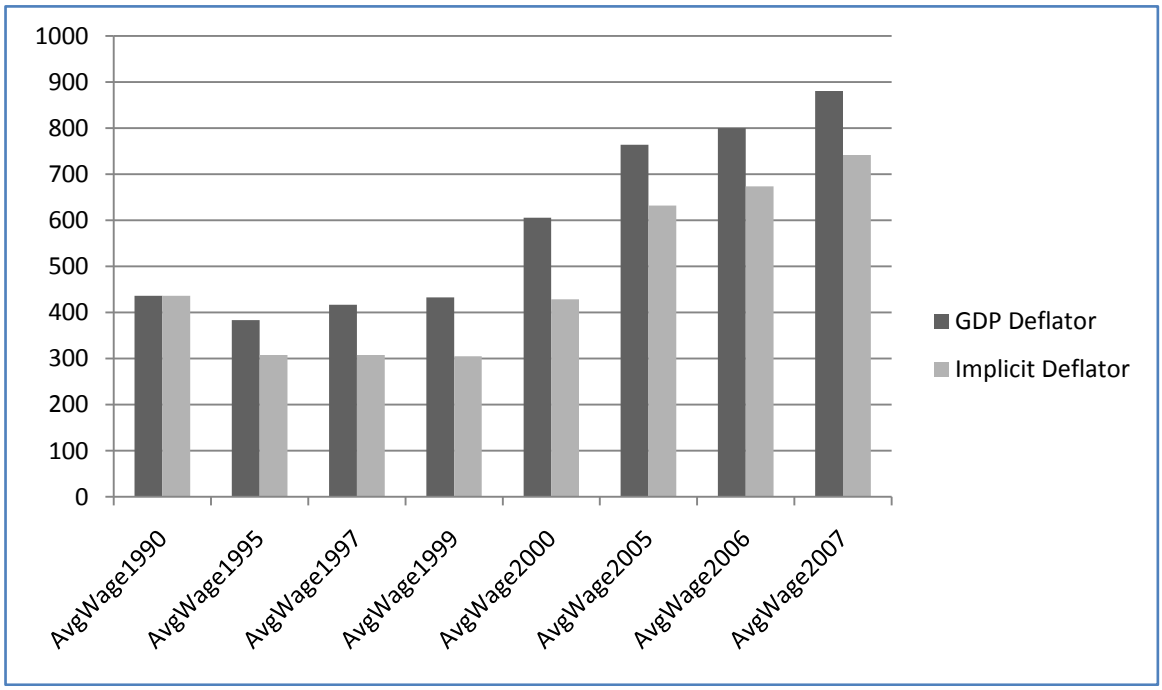
prices to decline nearly 60 percent in real terms. The trends in the period covered by the 2008 survey are in sharp contrast, with output prices roughly constant (declining by about 4 percent in real terms) and mean wages increasing by nearly 40 percent. The decrease in profits had important implications for the evolution of production methods and product quality, as we discuss below.

Table 3. Wages and prices

	Wages/Value Added	Monthly Wage (Yuan)		Output Price
		Men	Women	Last Year of Survey = 100
2008 Survey				
2000	0.49	72.2	72.7	104
2005	0.54	90.8	90.7	104
2006	0.55	93.1	92.2	101
2007	0.5	100.0	100.0	100
2000 Survey		All Workers		
1990	0.28	100.8		172
1995	0.38	88.6		113
1997	0.53	96.4		107
1999	0.62	100.0		100

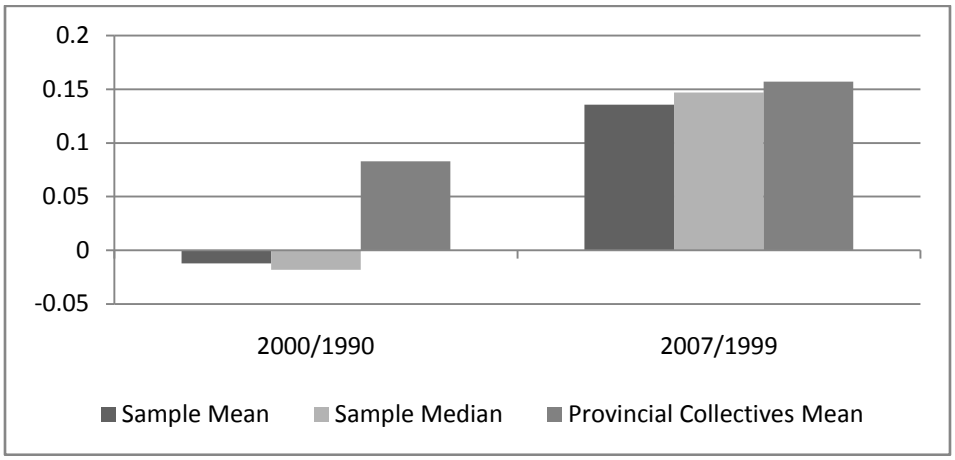
Notes:
a. Base years for wages and prices are 1990.
b. Wage index is based on mean wage over sampled firms.
c. Output price in 2008 survey is mean reported per-unit price of output sold.
d. Index is calculated for each firm and then averaged over all firms.
e. Output price in 2000 survey is reported mean price of output produced in highest volume.

Figure 1. Real monthly wages



Note: This chart shows average reported monthly wages in each year across both surveys. All values have been deflated to 1990 yuan using the GDP deflator and the implicit deflator derived from the real and nominal wage data in the Zhejiang Statistical Yearbook.

Figure 2. Annualized growth rate of wages: Sample firms vs. province, 1990–2000 and 1999–2007



Note: Wages deflated to 1990 with data from the Zhejiang Statistical Yearbook 2008, Table 5-6.

Figure 3a. Median profit per unit of invested capital net of implicit entrepreneur compensation

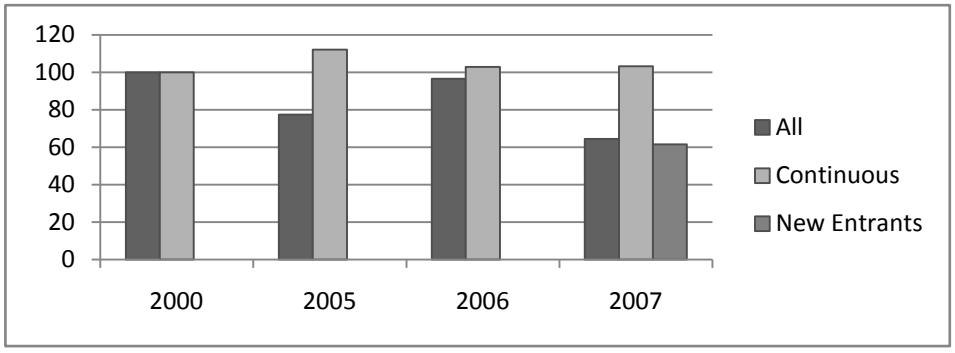
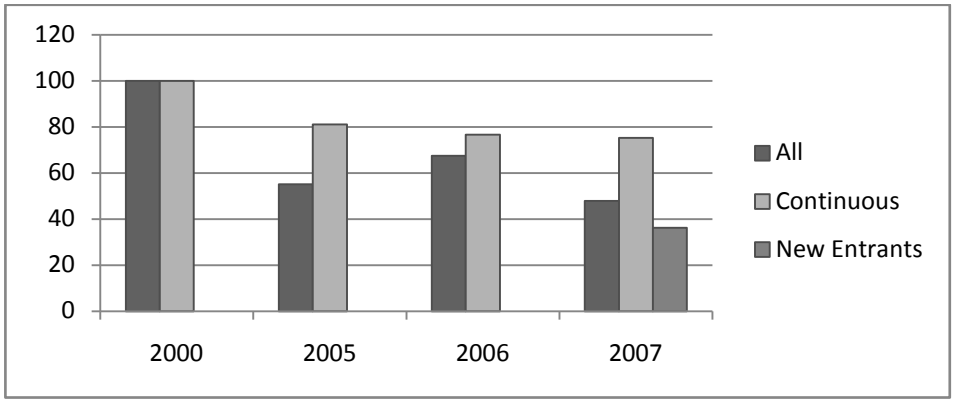


Figure 3b. Median profit per unit of invested capital unadjusted for implicit entrepreneur compensation



Note: Profit in Figure 3a is calculated as (Total Revenue – Total Cost – Compensation to the Entrepreneur). We assume the entrepreneur was compensated at 1.5 times the annual salary paid to the average worker he employed. The values on the vertical axis have been indexed to set profit in the year 2000 as the base year = 100. All prices and wages were deflated to 1990 using the GDP deflator for Zhejiang.

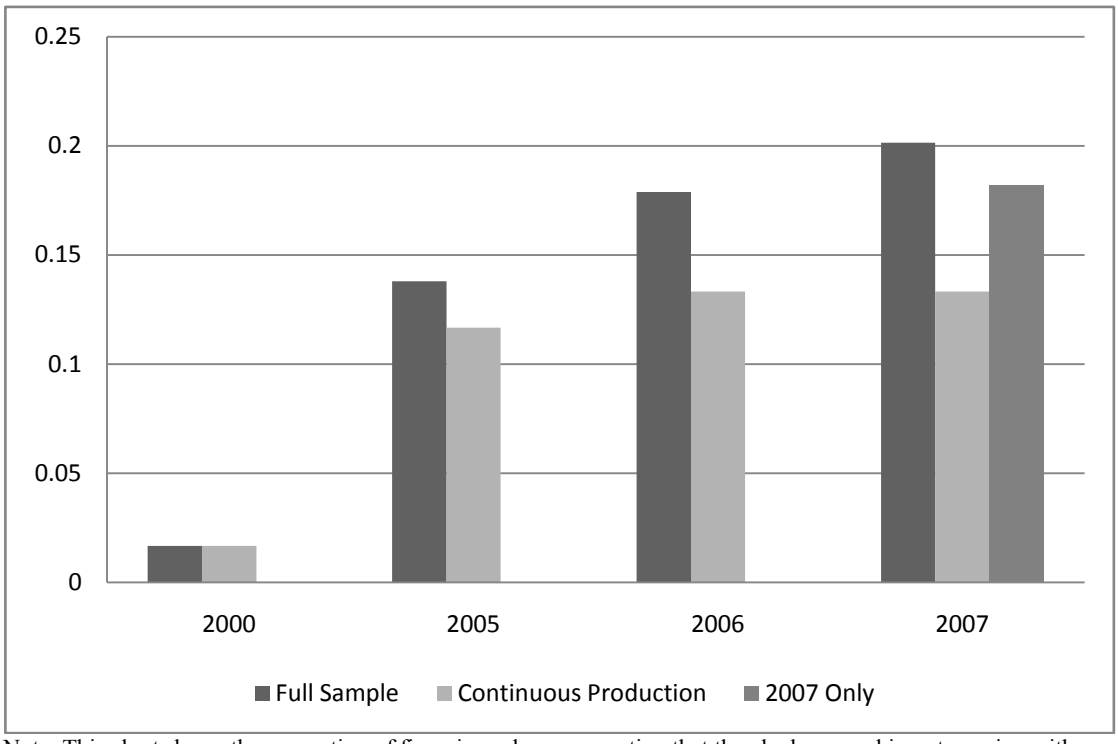
4. EVOLUTION OF THE INDUSTRY

In this section, we discuss changes in industry structure and manufacturing complexity.

Specialization in Production and Outsourcing

There is no information on outsourcing in the 2000 survey. Figure 4 shows the proportion of firms outsourcing in the 2008 survey, and the trend is sharply upward. Between 2000 and 2006, the proportion of firms in the full sample that reported outsourcing some production rises from about 2.5 percent to about 12.5 percent, and the proportion of firms outsourcing among the 16 firms entering the sample in 2007 is about 18 percent.

Figure 4. Proportion of firms outsourcing



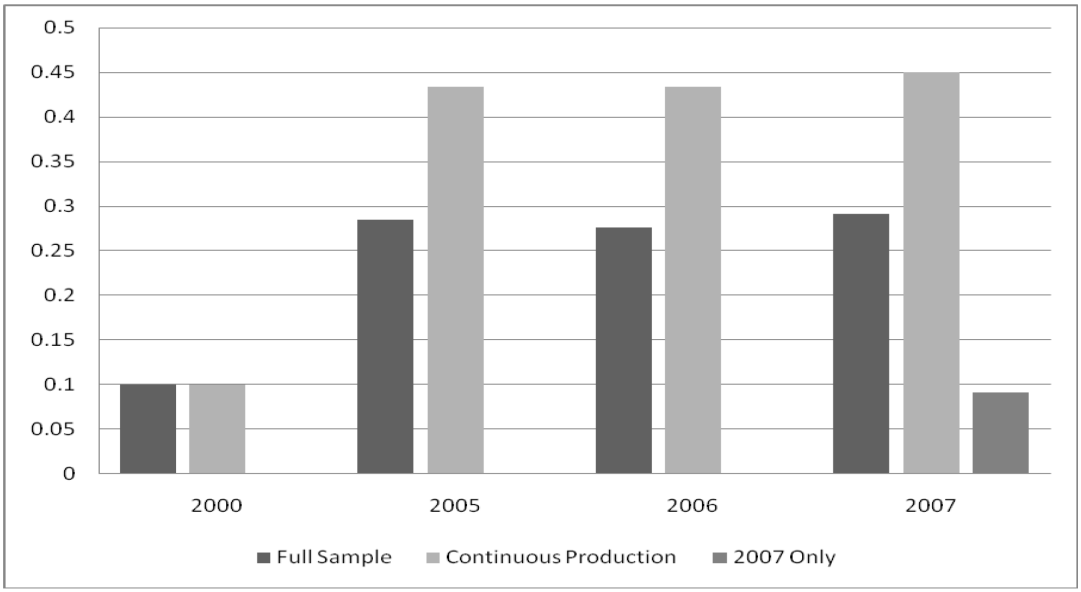
Note: This chart shows the proportion of firms in each year reporting that they had engaged in outsourcing, either sending or receiving outsourcing orders.

Branding and Quality

As discussed above, rising competition can create lower profits and a tendency for firms to cut costs, resulting in a self-defeating "race to the bottom" in terms of lower product quality and employee safety. In the 2008 sample, inflation-corrected profits were only 19 percent higher in 2008 than in 2000 despite a near tripling of real output. Real profits were actually lower in 2008 than in 2005. As discussed in section 2, industry leaders understand the implications of lower profits and they have promoted quality certification and development of brand names to create credible indicators of product quality and integrity. Branding and quality certification require investments of entrepreneurs' time and money. They are a signal to the market that the firm will lose its investment if its products fall short of promised quality. Moreover, they provide a barrier to effective competition from firms that lower quality to cut costs. Figures 5 through 8 show the proportion of firms in the 2008 sample that have obtained and that have applied for trademarks and certification from the International Office of Standardization (ISO). The

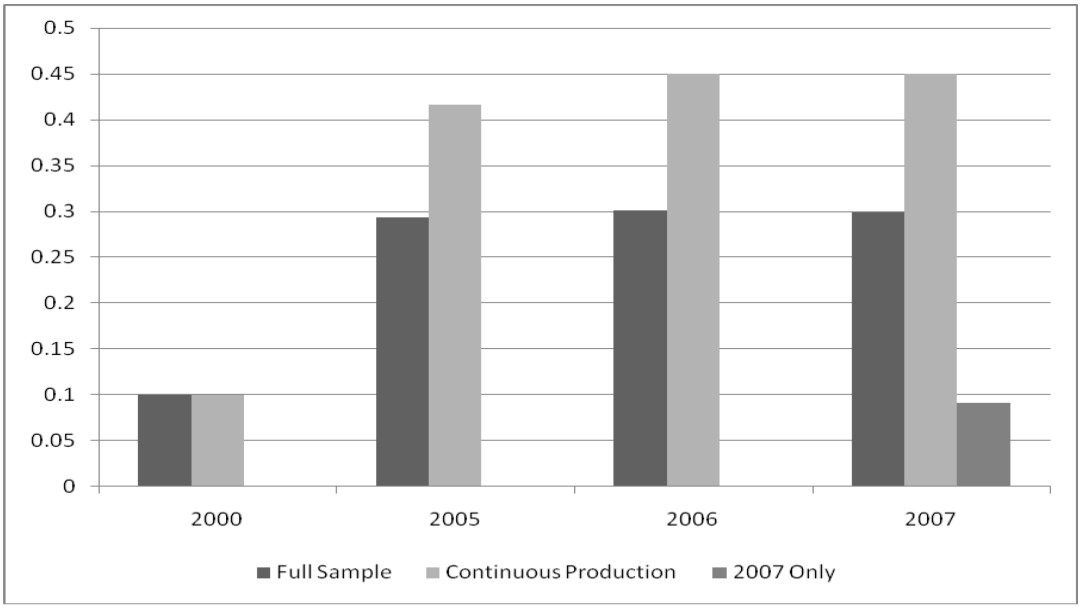
proportion of firms in the survey with trademarks grew from 10 percent in 2000 to about 38 percent in 2005 and to 40 percent by 2007. There were no firms with ISO certification in 2000, although 10 percent of firms had applied. Nearly 45 percent of firms had achieved ISO-certified status by 2006. It is noteworthy that, among firms appearing in the sample in 2007, less than 10 percent had registered trademarks and a similar number had applied; a similar gap appears for firms with and applying for ISO certification. We take this as further evidence of increasing specialization in production—that is, these new firms are frequently suppliers of semifinished products to firms further down the production chain do not depend on trademarks or ISO certification to establish their bona fides to their customers.

Figure 5. Proportion of firms with a registered trademark



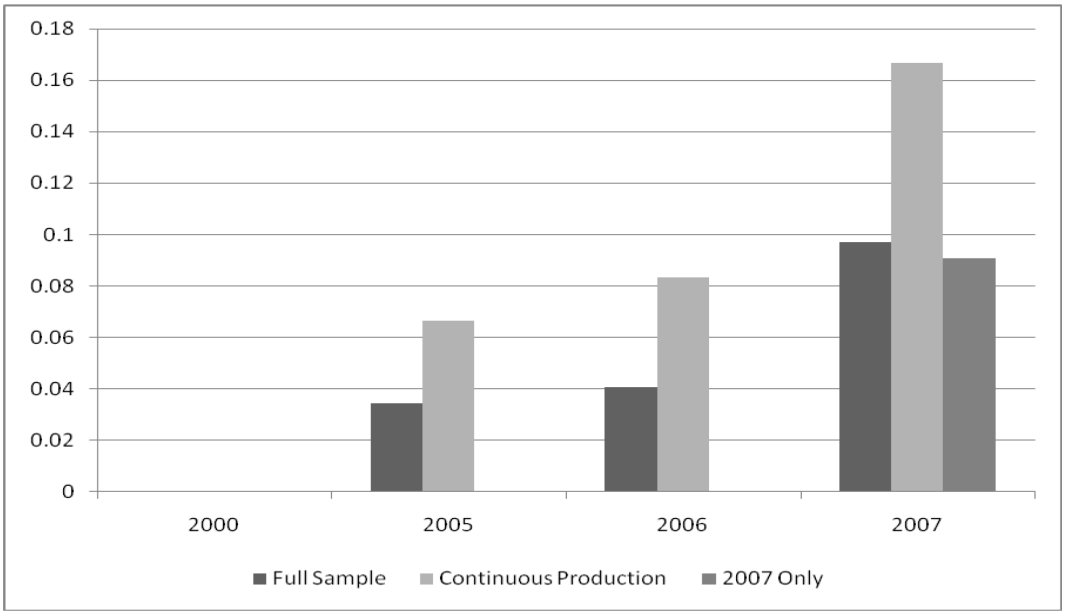
Note: This chart shows the proportion of firms in each year reporting that they had successfully registered a trademark.

Figure 6. Proportion of firms with submitted trademark applications



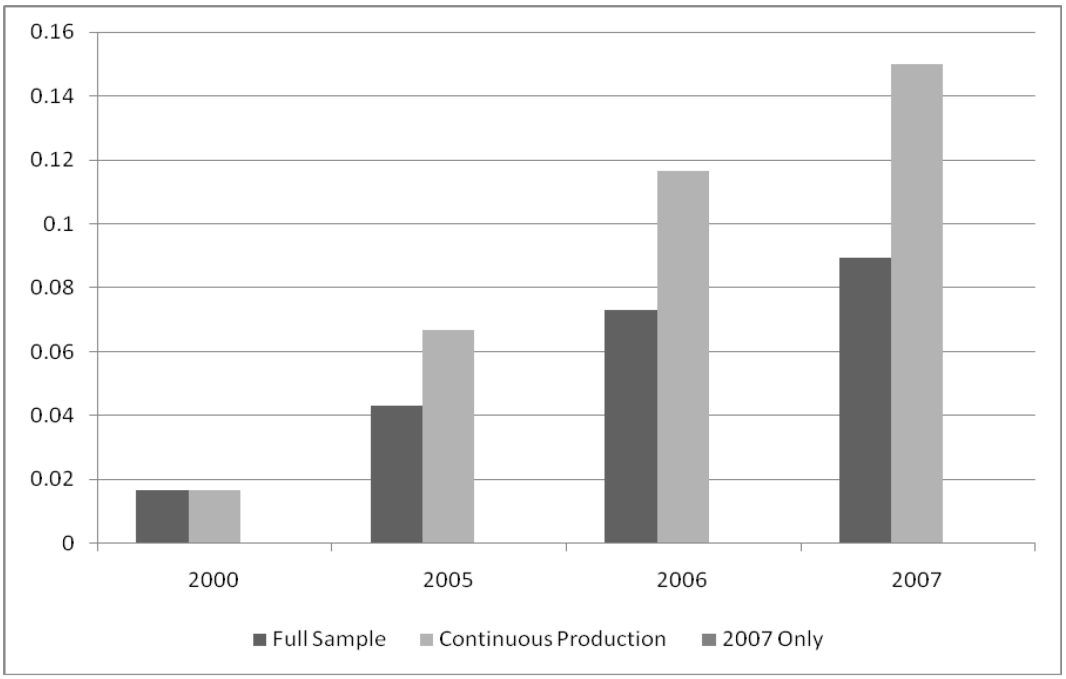
Note: This chart shows the proportion of firms in each year reporting that they had submitted an application for a trademark.

Figure 7. Proportion of firms with ISO certification



Note: This chart shows the proportion of firms in each year reporting that they had received ISO certification.

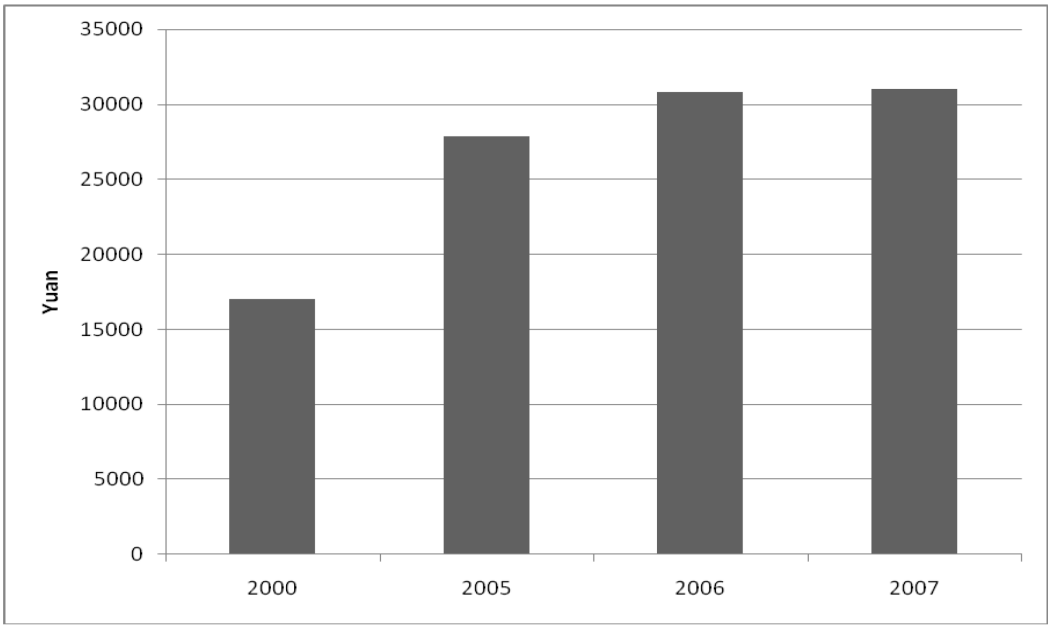
Figure 8. Proportion of firms with submitted ISO certification applications



Note: This chart shows the proportion of firms in each year reporting that they had submitted an application for ISO certification.

Figure 9 shows mean investment in design over the sample period. The average investment (including firms that reported spending nothing on product design) jumped about 64 percent in real terms between 2000 and 2005 and another 11 percent between 2005 and 2007.

Figure 9. Investment in design



Note: This chart shows the average levels of investment in design between 2000 and 2007. Expenditures were deflated back to 1990 yuan using the GDP deflator.

Does Quality Pay? Evidence from Price Data

Industry efforts to avoid a "race to the bottom" in terms of product quality would fail if consumers were not willing to pay for the cost of producing better-quality merchandise. Measures of consumers' demand for quality can be obtained from estimates of hedonic price indexes for product characteristics. We specify hedonic indexes as follows:

$$\ln UP_{it} = A \cdot \sum_{j} \beta_j X_{it} + \varepsilon_{it} \tag{1}$$

where UP_{it} is the reported unit price of output for firm i at time t, where the X_{it} are various characteristics of the items produced by the firms in our sample.

These characteristics include the following:

- Expenditure on raw material per unit of output;
- Total annual expenditure on product design by the firm;
- A dummy variable equal to 1 if the firm has received ISO certification or has a registered a trademark;
- Two variables representing the proportion of a firm's output declared to be "high quality" or "medium quality" garments, respectively. These quality measures should be interpreted to reflect the type of market to which the respective items are intended to be sold. ("Low quality" is the omitted quality category.)
- A variable representing the proportion of the firm's output produced for the "toddlers" market (versus "teens").

We take the estimated parameters β as equilibrium outcomes of firms' costs, their desire to place themselves in particular markets, and consumer preferences.

Estimation results for the hedonic index equation (1) are reported in Table 4. The simplest formulation is shown in column 1. The estimated coefficients of raw materials, design expenditure, and the ISO or trademark dummy are all positive and significant. The coefficients imply that a 1-yuan increase in raw material content of a garment is associated *cet. par.* with a 2 percent increase in price per

unit, that a 10,000 increase in total design expenditure per year is associated with a 1 percent increase in price, and the presence of ISO certification or a trademark is associated with a 27 percent higher product price.

Table 4. Hedonic price indices

	1	2	3	4
RM Cost per Unit	0.02* (2.42)	0.17** (5.44)	0.15** (6.16)	0.13** (4.78)
Design Expenditure (total)	0.01** (2.55)	0.01** (2.60)	0.004* (2.02)	0.25** (2.51)
ISO Cert. or Trademark	0.27** (7.38)	0.28** (7.47)	0.20** (4.74)	0.17** (4.03)
High Quality			0.66** (4.86)	0.63** (3.72)
Medium Quality			0.37** (4.45)	0.39** (3.54)
Toddler			-0.20* (-2.46)	-0.15 (-1.79)
Report Year after 2000		0.65** (3.76)	0.58** (4.39)	0.57** (4.27)
After 2000* RM Cost		-0.15** (-4.59)	-0.13** (-5.07)	-0.12** (-4.84)
High Quality* RM Cost				0.04** (1.94)
Medium Quality* RM Cost				0.02 (1.09)
High Quality* Design Expenditure				-0.25** (-2.53)
Medium Quality* Design Expenditure				-0.24* (-2.46)
R2	0.37	0.40	0.50	0.64
n	287	287	286	286

Notes:
a. The dependent variable is the logarithm of average unit price of output reported by the firm.
b. RM per unit is total expenditure on raw materials in yuan divided by the total number of units produced by the firm in a year.
c. Design Expenditure is firm's total expenditure on design in a year in 10,000 yuan.
d. ISO Cert. or Trademark is a dummy variable for whether a firm has received ISO certification or has registered a trademark.
e. High Quality is the proportion of firm's product lines that are self-identified as being high quality. Medium Quality is the proportion of firm's product lines that are self-identified as being medium quality. The omitted category is low quality.
f. Toddler is the proportion of firm's product lines manufactured for toddlers. The omitted category is proportion manufactured for teens.
g. Year after 2000 is a dummy variable for whether an observation was reported for the years 2005, 2006, or 2007. The omitted category is observations reported for the year 2000.
h. t values are in parentheses and were calculated using robust standard errors.
i. ** and * indicate significance at the 1% and 5% levels, respectively.
j. R2 and n refer to adjusted R2 values and sample size, respectively.

In column 2 of Table 4, we see that when a dummy variable = 1 for data in a reporting year after 2000 is included in the hedonic regression, along with its interaction with the raw material variable, we observe the interesting result that the relative hedonic weight of raw material/unit is much higher in the year 2000 than in later years. This decline in the relative weight of raw materials is consistent with rising emphasis on product quality by producers and rising demand for quality by consumers over time. Columns 3 and 4 report results for hedonic equations that include additional characteristic variables. Not

surprisingly, high- and medium-quality production are both associated with significantly higher per unit prices and low-quality production, and "toddlers" garments are priced lower than "teens" garments, holding constant other product characteristics. When the design variable is interacted with the quality variables, the estimated coefficient of the design variable is much larger than in the regression that does not include these interaction terms, while the two interaction terms are both negative. While a negative interaction between declared quality and design expenditure may at first appear to be counterintuitive, we interpret this result to imply that firms experience diminishing returns to investments in design once their output has risen above a certain quality threshold.

Performance

We discuss two measures of firm performance: (i) profit per unit of invested capital, and (ii) production function parameters. Production functions are estimated only with data from the 2008 survey because although the 2008 and 2000 surveys were designed to collect the same information, there are items in the 2008 that are not included in the 2000 survey, such as amount spent on design and additional information on the capital stock.

We specify both a value-added production function and a total-output production function in Cobb-Douglas form as follows.

$$Y_{it} = AL_{it}^{\alpha} K_{it}^{\beta} + \varepsilon_{it}, \tag{2}$$

and

$$Q_{it} = \mathrm{A}L_{it}^{\alpha} K_{it}^{\beta} \prod_{n} X_{it}^{\gamma_n} + u_{it} \tag{3}$$

where Y and Q are value added and total output, respectively, for firm i in year t; L and K are measures of labor and capital, respectively; the X_n are intermediate inputs including raw materials, semi-manufactured garments, design costs, and so on; and ε and u are iid error terms. The evidence from our estimates of hedonic price indexes suggests that design and other expenditures on product characteristics are inputs that should be treated similarly to raw material and intermediate inputs in the production process. In one specification of the production function we also include a dummy variable for the year of observation to capture total factor productivity (TFP) changes over time.

Profit per Unit of Invested Capital

Figures 3a and 3b show the trend of median profit as a proportion of invested capital in the 2008 sample. In Figure 3a, profit is calculated as reported sales valued in current prices minus all reported costs, adjusted for the implicit wage of the entrepreneur, and deflated by the gross domestic product (GDP) deflator for Zhejiang using 1990 as the base year; invested capital is deflated as described in the discussion of Table 2. The profit ratios are indexed to the year 2000 = 100[5]. In Figure 3a, profit/invested capital for all firms falls between 2000 and 2005, rises in 2006, and falls by a rather large amount in 2007. On the other hand, the profit ratio for the "survivor" firms that existed in 2000 is somewhat higher in 2007 than in 2000. The ratio for new entrants is a little lower (in 2007) than for all firms taken together. When profit is not adjusted for the implicit salary of the entrepreneur, the profit ratio is lower in 2007 than in 2000 in all cases. However, the firms that continuously operated from at least 2000 experienced a smaller relative decline than did the sample as a whole. We note three possible causes of the relatively low profit ratio for the larger sample of firms in 2007 and for new entrants than for those in continuous operation: (i) we have better estimates of investment for younger firms because of the shorter period of time covered by the data; (ii) rising wages have cut into the profit rate of new firms more severely than

[5] The calculation of profit is problematic for at least one reason, in addition to normal recall and record keeping problems associated with these small firms: Although we have data for initial investment in all firms, for firms established before 2000 we lack data on investment in years between the date of founding and the year 2000.

into the profit rate for older firms, perhaps due to sluggish wage adjustments for employed workers; (iii) as noted in the introduction, in recent years, safety requirements have raised costs, and these requirements for safe workplaces may more severely affect new firms.

Production Function

Production function estimates are reported in Table 5. Estimation results for the value-added specification are reported in columns 1 through 3 and those for the total-output specifications in column 4 through 6. The simplest specifications are reported in columns 1 and 4. In both specifications, the estimated output elasticities sum to approximately unity, indicating approximate constant returns to scale. The estimated labor elasticities are about four times the magnitude of the estimated capital elasticities.

In the estimates reported in columns 2 and 5, the capital variable is defined net of design expenditure and design expenditure is included as a separate input in addition to a dummy variable indicating whether a firm has achieved ISO certification. The estimated coefficients of the additional variables are all positive and statistically significant, and the estimated elasticity of "net" physical capital falls by about one-half. The estimated elasticity of labor is also somewhat lower. The presence of ISO certification raises value added by about 25 percent and the value of output by about 16 percent.

The estimates reported in columns 3 and 6 include a dummy variable equal to 1 if the reporting year is not 2000, the year in which there are the smallest number of firms, all of which have survived long enough to be surveyed in 2008. The estimated coefficient of the "after 2000" variable thus captures two opposing forces: (i) surviving firms are expected to be more productive than the average firm; (ii) competitive factors and learning should raise productivity over time. The "after 2000" dummy is also interacted with the other inputs to test for patterns suggested in the hedonic-index estimation: that the marginal value of intermediate inputs relative to other product characteristics has declined over time. The estimated coefficients of the "after 2000" dummy and its interactions all have the expected signs, but they are statistically insignificant in the value-added specification. In the total-output production function results reported in column 6, the "after 2000" coefficient indicates that TFP increased significantly after 2000 and that the estimated elasticity of intermediate inputs fell relative to those of other inputs, consistent with the hedonic price index results. The estimated coefficient of the "after 2000" dummy with labor indicates that the output elasticity of labor is higher in the years after 2000.[6]

Overall, TFP in the cluster appears to have grown gradually over the period following 2000. This TFP growth understates the contribution of the cluster to regional TFP growth because a major source of China's outstanding economic growth in the reform era has been movement out of agriculture and from traditional to more technologically advanced industries (Zhang and Tan 2007). Because the labor productivity in the nonfarm sector is higher than the agricultural sector, even if TFP in the nonfarm sector maintains constant, a simple reallocation of labor from the agricultural sector will lead to overall economic growth.[7]

The production function estimation results are consistent those of the hedonic price index and support the hypothesis that output value is determined by characteristics associated with design and other measures of quality in addition to "pure" raw material. Attempts to corroborate the production-function estimation results using firm fixed-effect regression yield very imprecise estimation results.

[6] Estimates based on more complete sets of interaction terms yield statistically insignificant coefficients. Estimates based on firm fixed effects yield approximately the same estimated coefficients for labor and intermediate inputs, but smaller and insignificant estimated coefficients for capital stock.

[7] According to the simulation by Zhang and Tan (2007), reallocating even 1 percent of the agricultural labor force could increase national GDP by 0.9 percent.

Table 5. Production function estimates

	1	2	3	4	5	6
Dependent Variable:		**Log VA**			**Log Output**	
Constant	-0.66	0.22	-0.07	4.73**	5.34**	1.49**
	(-1.62)	(0.48)	(-0.08)	(13.26)	(13.18)	(2.72)
Log L	0.83**	0.72**	0.78**	0.43**	0.37**	0.14*
	(12.62)	(9.27)	(3.58)	(8.34)	(6.25)	(1.96)
Log RM				0.49**	0.49**	0.85**
				(14.02)	(11.79)	(17.73)
Log K	0.21**			0.11**		
	(5.15)			(4.40)		
Log Physical Capital		0.09*	0.08		0.05	0.04
		(2.02)	(1.74)		(1.65)	(1.29)
Certification		0.23*	0.22*		0.15**	0.15**
		(2.33)	(2.18)		(2.82)	(2.75)
Log Design		0.10**	0.11**		0.04*	0.04
		(2.87)	(3.02)		(1.94)	(1.75)
Report Year After 2000			0.48			4.08**
			(0.67)			(6.38)
After 2000* Log L			-0.07			0.26**
			(-0.31)			(2.59)
After 2000* Log RM						-0.38**
						(-6.12)
R2	0.62	0.66	0.66	0.83	0.86	0.87
n	322	270	270	332	275	275

Notes:

a. The dependent variables are Value Added defined as value of output less value of raw materials measured in 1990 yuan and Output, which is total value of output in 1990 yuan.

b. L is firm total employment in a given year.

c. RM is the total value of raw materials purchased by the firm in yuan.

d. Physical Capital is the sum of the firms' reported investment flows and the value of the workplace in a given year. The depreciation rate applied is 10% per year.

e. K is the sum of Physical Capital and the amount invested to achieve a trademark and ISO certification. The depreciation rate applied was 10% per year.

f. Report Year After 2000 is a dummy variable for whether an observation was reported for the years 2005, 2006, or 2007. The omitted category is observations reported for the year 2000.

g. Design Expenditure is firm's total expenditure on design in a year in 10,000 yuan.

h.Certification is a dummy variable for whether the firm has ISO certification or a registered trademark.

i.t values are in parentheses and were calculated using robust standard errors

j. ** and * indicate significance at the 1% and 5% levels, respectively.

k. R2 and n refer to adjusted R^2 values and sample size, respectively.

5. SUMMARY

Our overview of the evolution of firms in the Zhili children's garment cluster highlights critical features of one of the most important drivers of China's spectacular growth during the reform period as well as some significant limitations. The average firm in Zhili in 2007, the last year included in the 2008 sample, is 75 percent larger in terms of output than the average firm in 2000 and more than 7 times larger than in 1990, the first observation year of the 2000 survey. At the same time, the dispersion of output and employment among firms has grown immensely. One indicator of rising dispersion of firm size can be seen by comparing median employment, which grew from 20 workers per firm in 2000, first year of the 2008 survey, to 26 workers, an increase of 30 percent, while the ratio of mean employment of the top quartile of employers to the bottom quartile grew to nearly 11 from 7. The far greater increase in output dispersion than employment dispersion implies a substantial growth in the dispersion of average labor productivity. The divergence in firm size is associated with a significant increase in specialization among firms, indicated by the proportion of firms that outsource some of their production, which grew from about 2 percent of all firms in 2000 to approximately 20 percent of all firms in 2007.

Although startup costs have risen significantly—median initial investment among firms founded after the year 2000 is about twice as large in real terms as among those founded before 1990—many entrepreneurs can still afford to enter the business using their own savings. The cluster-based production structure provides a good opportunity for many ordinary farmers with limited capital to become entrepreneurs. Moreover, rising incomes have provided more resources for business investment. Formal bank financing still accounts for only a small fraction of initial investment. The rather low initial investment threshold has facilitated business entries and therefore intensified competition in both the product market and the labor market. Not surprisingly, profit margins declined as prices fell (during the years covered by the first survey) and wage costs shot up (during the years covered by the second survey).

Avoiding a "race to the bottom" in terms of declining profit margins and declining quality (Sonobe and Otsuka 2006) while maintaining employee safety is a major structural problem facing this highly fragmented industry. The township government has imposed safety regulations in response to major industrial accidents, and the firms themselves have taken steps to signal their commitment to product quality by investing in trademarks and ISO certification. Moreover, our estimates of hedonic price indexes and production functions support the hypothesis that consumers are willing to pay for additional product quality. By the year 2007, nearly half of the firms in Zhili had established registered trademarks and nearly 20 percent had become ISO certified. Firms whose main function is to serve as subcontractors for enterprises producing finished products for the wholesale and retail markets are monitored by their outsourcing partners, and the payoff for establishing a trademark is reduced. This characteristic may account for the very low proportion of registered trademarks and absence of trademark applications among firms entering the data in 2007.

We have used two measures of firm performance: profit per unit of invested capital, and total factor productivity. The ratio of profit to invested capital is substantially lower in 2007 than in 2000, at least for firms that have not been in continuous operation since 2000 or earlier. However, TFP has tended to rise over time. We conjecture that the low profit ratio is attributable to some combination of rising wage costs, a more accurate measure of total investment, and stricter imposition of safety regulations.

Clustering within established communities where long-time relationships among family and neighbors prevail offers an institutional substitute for court enforcement of contractual relationships among borrowers and lenders and between outsourcing firms and their subcontractors. Local government has served a facilitating role in the innovation of institutional arrangements to prevent a destructive "race to the bottom" in terms of product quality and employee safety. Employment opportunities provided to workers with negligible productive opportunities in farming in Zhili and nearby locations have been a major contributor to rising aggregate TFP growth. However, rising wage costs imply that the supply of labor is not as highly elastic as in the past. The cluster's future growth will depend on higher rates of investment in both tangible and intangible capital (design costs, trademarking, copyrighting, etc.) Small

investors will be increasingly consigned to operate as subcontractors for producers of brand-name clothing, and formal contract enforcement may become an issue. These changes will likely require not only an upgrade of contractual formalities but also of the courts' ability and willingness to fairly and transparently enforce loan contracts and other contractual arrangements. We hope that local and regional governments will respond positively to this need, as they have to the need for quality and reputational certification. Such responses to existing institutional inadequacies can provide a critical stepping stone on the path to ensuring China's continuing growth and to showing the way to other developing nations.

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